

REMARKS

Favorable reconsideration of this application in view of the remarks to follow is respectfully requested. Since the present Response raises no new issues, and in any event, places the application in better condition for consideration on appeal, entry thereof is respectfully requested under the provisions of 37 C.F.R. §1.116.

The present response addresses the Examiner's comments in the Advisory Action dated July 9, 2009, in which the Examiner withdrew the objection to the specification and the § 112 rejections that were included in the Final Office Action dated April 17, 2009. The Examiner maintained the § 103 rejections stating the following:

“Xiang clearly teaches: “halo regions extend beneath the gate 54 to beyond the anticipated locations of the ends of the source and the drain extensions 60”. (col. 6, lines 1-11). It is well known in the art that “punchthrough” occurs when the S/D extensions are encroached into the channel region. The formation of carbon and halo regions inhibit diffusion of the source and drain into the channel region. As has been mentioned, both carbon and halo ions are located in the strain layer including the interface.”

Applicants have amended Claim 1 to recite that the semiconductor field effect transistor includes a peak concentration of blocking impurity dopant materials that are selected from the group consisting of In, Pb, Sb and Sn, and are located substantially at the interface and are extending across the entirety of the interface between the source region and the drain region. Applicants submit that the applied prior art fails to teach or suggest this limitation of amended Claim 1. Support for the amendment to Claim 1 is found in Figures 6(d) to 6(h) of Applicants' specification. Turning to the outstanding grounds of rejection.

Claims 1, 2 and 4-6, stand rejected, under 35 U.S.C. § 103, as allegedly unpatentable over U.S. Patent No. 6,749,527 to Xiang ("Xiang") in view of Applicants' Admitted Prior Art (AAPA) and U.S. Patent No. 6,432,802 to Noda et al. ("Noda et al."). Applicants traverse the aforementioned rejections and submit the following.

To establish a prima facie case of obviousness of a claimed invention all the claimed limitations must be taught or suggested by the prior art. *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 44, 496 (CCPA 1970).

Xiang et al. fails to render Applicants' claimed structure unpatentable, because Xiang et al. fails to teach or suggest each and every limitation of amended Claim 1. Specifically, Xiang et al. fails to teach or suggest a semiconductor field-effect transistor device that includes a peak concentration of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn located substantially at an interface between a first strained layer of semiconductor material and a SiGe substrate and extending across the entirety of the interface between the source region and the drain region, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface and substantially inhibit diffusion of the implanted source and drain dopants from diffusing along the threading dislocations, misfit dislocations or crystal defect along the interface, as recited in amended Claim 1.

Xiang does not teach or suggest blocking impurity dopant materials that occupy one or more threading dislocations, misfit dislocations or crystal defects. Xiang discloses a structure in which the mobility of a strained silicon layer is augmented through incorporation of carbon into a strained silicon lattice to which strain is also imparted by an underlying silicon germanium

layer. To provide the strain augmentation, Xiang discloses a carbon implant into silicon, which fails to teach or suggest a peak concentration of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn, in which the implant is located substantially at an interface between a first strained layer of semiconductor material and a SiGe substrate, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface, as recited in Claim 1.

Referring to the Advisory Action, the Examiner states that “there are two groups of ions in Xiang that can function as “blocking impurity dopant”, i.e., neutral: carbon ions and conductive: halo ions. Both of which are implanted into the strained layer including the interface between the strain layer 42 and the layer 40.”

Applicants submit that the neutral carbon ions disclosed in Xiang fail to meet the claimed limitation of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn, in which the implant is located substantially at an interface between a first strained layer of semiconductor material and a SiGe substrate, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface, as recited in Claim 1. First, carbon is not included within the claimed Markush group. Second, the carbon employed in Xiang is not present having a peak concentration of blocking impurity dopant materials at the interface between the silicon layer and the silicon germanium layer, in which the blocking impurity dopant materials are present on the interface extending across the entirety of the interface between the source region and the drain region. In order to provide increased strain in the surfaces of the silicon layer in which the channel is present, which is the objective of Xiang, Xiang employs carbon in greater amounts at

the upper surface of the silicon layer than at the interface between the semiconductor layer and the underlying silicon germanium layer. Increasing the carbon content increases the stress because it modifies the lattice dimension spacing. Employing carbon at a peak concentration at the interface of the silicon layer and the underlying silicon carbon layer and reducing the carbon content towards the surface of the silicon layer would allow the silicon layer to relax, therefore diminishing the performance increases that result from the strain enhancement. Therefore, the carbon disclosed in Xiang fails to meet the limitation of Applicants' claimed impurity blocking element, in which the peak concentration of blocking element is present at the interface of the first strained layer and the semiconductor substrate, as recited in amended Claim 1.

Turning to the halo regions disclosed in Xiang, Applicants observe that halo regions are present abutting the source/drain regions, but do not extend from a first source/drain region across the entirety of the substrate to the opposing source/drain region. Therefore, Xiang fails to meet the claimed limitation of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn, in which the peak concentration of the blocking impurity dopants are located substantially at an interface between a first strained layer of semiconductor material and a SiGe substrate and extends across the entirety of the interface between the source and drain regions, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface, as recited in amended Claim 1.

Noda et al. fails to fulfill the deficiencies of Xiang et al. Noda et al. provides a method of fabricating a semiconductor structure in which an amorphous layer is formed into a semiconductor region by implanting heavy ions with a large mass using a previously formed gate

electrode as an ion implantation mask. Applicants observe that in Noda et al. the substrate 100 is shown as a single material. As such, Noda et al. does not teach or suggest a structure including a strained semiconductor layer located atop a substrate in which an interface is present between the two material layers. Since no interface is present between a strained semiconductor layer and an underlying substrate within Noda et al., the applied reference cannot and does not teach or suggest a structure in which a peak concentration of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn is located substantially at an interface between a first strained layer of semiconductor material and a SiGe substrate and extends across the entirety of the interface between the source region and the drain region, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface and substantially inhibit diffusion of the implanted source and drain dopants from diffusing along the threading dislocations, misfit dislocations or crystal defect along the interface, as recited in Claim 1.

Applicants observe that the Examiner relies on the halo implants within Noda et al. for allegedly teaching utilizing the use of In, Pb, Sb and Sn. Applicants submit in this regard that In, Pb, Sb and Sn are used to form halo implants that are located within a doped layer 103 of semiconductor substrate 100 as provided in Noda et al. After annealing, the halo implants are activated forming doping pockets 106A that are located beneath the source/drain regions 105A. See FIG. 1C of Noda et al. A separate doping pocket 106A is present on each source/drain region 105A, but the doping pockets 106A do not extend across the substrate from the first source/drain region to the opposing source/drain region. Therefore, Noda et al. fails to teach or suggest blocking impurity dopant materials extending across the entirety of the interface between

the source region and the drain region, as recited in amended Claim 1. As illustrated, the peak concentration of the doping pockets within Noda et al. is not located substantially at an interface between a strained semiconductor layer and an underlying substrate and extending between the source region and the drain region, as presently claimed.

Applicants further submit that one of ordinary skill in the art would not substitute the halo dopants disclosed in Noda et al. for the carbon that is being implanted to provide a strained material in Xiang et al. Halo dopants, which are utilized to decrease diffusion of source and drain dopants, which provide the charge carriers of a semiconductor device, are far removed from implants that modify the crystalline structure of a semiconductor structure. Applicants submit that the Examiner has failed to provide sufficient reasoning why one of ordinary skill in the art would combine a reference that discloses forming strained semiconductor materials, i.e., Xiang et al., with a reference that discloses a means to reduce diffusion of source and drain dopants, i.e., Noda et al., in a manner that would meet the limitations of Applicants' claims. Specifically, the Examiner has failed to provide reasoning why one of ordinary skill in the art would substitute a dopant species for halo regions, as taught in Noda et al., with a dopant species to modify the crystal structure of a semiconductor material, as taught in Xiang et al., where the dopant species would block threading defects at the interface of a first strained layer of semiconductor material and a SiGe substrate, as required by Applicants' claims.

Turning to the AAPA, Applicants observe that the AAPA fails to teach or suggest a semiconductor field-effect transistor device that includes a peak concentration of blocking impurity dopant materials selected from the group consisting of In, Pb, Sb and Sn located substantially at an interface between a first strained layer of semiconductor material and a SiGe

substrate and extending across the entirety of the interface between the source region and the drain region, wherein the blocking impurity dopant materials partially or fully occupy each of the one or more threading dislocations, misfit dislocations or crystal defects at the interface and substantially inhibit diffusion of the implanted source and drain dopants from diffusing along the threading dislocations, misfit dislocations or crystal defect along the interface, as recited in Claim 1. Further, the AAPA provides no guidance for combining the disclosures of Xiang et al. with Noda et al. to meet Applicants' claims.

The rejection under 35 U.S.C. § 103 has been obviated; therefore reconsideration and withdrawal thereof is respectfully requested.

Thus, in view of the foregoing amendments and remarks, it is firmly believed that the present case is in condition for allowance, which action is earnestly solicited.

Respectfully submitted,



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